

Clinical Practice Guideline

Microhematuria in Children and Young Adults

Evaluation for the Early Detection of Kidney Disease

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Summary

Background: Occult blood in the urine, or microhematuria, is a common finding (about 10%) in children and young adults. It is often of brief duration and therefore harmless. In persistent microhematuria, acanthocytes in the urine are a frequently unrecognized early marker of glomerular kidney disease. The purpose of this guideline is to promote the early detection of kidney disease in children and young adults with practical, evidence-based recommendations.

Methods: A systematic search for pertinent publications up to January 2023 was conducted in Pubmed, the Cochrane Database, and Livivo. 474 publications were retrieved, summarized in terms of method and content, and classified by Oxford (2011) evidence level.

Results: Approximately 1% of children and young adults have undiagnosed chronic kidney disease. Microhematuria is an early warning sign. A timely nephrological evaluation is indicated if microhematuria persists for 3 to 6 months, if $\geq 5\%$ acanthocytes are detectable in the urine, and if there is also proteinuria, hypertension, or impaired renal function. Ultrasonography of the kidneys and urinary tract is the imaging method of choice; cystoscopy should be

avoided. For patients with glomerular microhematuria, molecular genetic testing is recommended. Renal biopsy is recommended in case of florid glomerular diseases, after the determination of various laboratory parameters and clinical findings, including molecular genetic testing especially in children.

Conclusion: In the absence of a guideline until now, findings have often been incorrectly assessed, leading either to an inadequate work-up or to excessive diagnostics. As a result, in approximately 30% of young patients, valuable opportunities for early treatment to protect the kidneys have been missed.

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Occult blood in the urine is a common finding (about ten percent) in children and young adults. This degree of hematuria is often of brief duration and as such harmless. In some patients (around one to two percent), however, hematuria exists for a longer period of time (persistent microhematuria), without necessarily resulting in a medical problem. Persistence of microhematuria should always be verified, however, by means of repeated examination of the urine over three to six months using urine dip sticks. In the presence of persistent microhematuria, acanthocytes in the urine are highly specific markers of glomerular kidney disease (1–3). Acanthocytes are an abnormal variant of red blood cells with vesicle-like protrusions which develop when red cells are forced through very small lesions in the glomerular basement membrane. This carries a high risk of chronic kidney disease if proteinuria also develops (3–5).

Microhematuria often goes unrecognized, although the majority of kidney diseases in children and young adults are usually diagnosed early and in good time: With respect to microhematuria in children, adolescents, and

especially young adults in Germany, an average of almost ten years passes from the first symptom to diagnosis without action being taken (1, 2). If treatment is delayed, the kidneys of those affected fail a median of 15 years earlier than with timely diagnosis (1–5). The new S3 guideline “Hematuria in Children” closes this gap in the evidence-based care of young people with kidney disease. This guideline is intended to reduce the number of missed early diagnoses. At the same time, the creation of a practical recommended course of action on detecting microhematuria is intended to promote the early detection of kidney disease in children and young adults (1).

In Germany, every child is examined for the presence of microhematuria during the U8 check-up at the age of four years. However, due to the absence of guidelines, many results have in the past not been correctly classified, have led to no, or only inadequate, diagnostic

work-up, or possibly to excessive diagnostics. Where diseases are treatable, valuable opportunities for early therapeutic intervention to protect the kidneys are missed: In the majority of cases, treatment is most effective where severe renal damage has not yet occurred (1–3, 5, 6). Observational studies show that end-stage kidney failure can often be delayed by years or even prevented entirely (1). These developments, advances in genetic testing, and the associated opportunities for patients and affected families for early diagnosis and kidney-protective therapy – such as early blockade of the renin-angiotensin-aldosterone system (1, 6) – rendered the formulation of the current guideline urgently needed.

Methods

The guideline group comprised the guideline steering committee, elected representatives with voting rights, and other non-voting advisory experts together with the direct involvement of patient representatives (*eTable*). In accordance with the specifications of the Association of the Scientific Medical Societies in Germany (AWMF), the selection was multi-professional, multidisciplinary, and representative of the guideline's target users. The respective professional societies and organizations were responsible for nominating their representatives. In order to focus the systematic search of the literature, clinically relevant questions were defined and discussed at study meetings held by the Society for Pediatric Nephrology (GPN). The systematic search was conducted in PubMed, the Cochrane Database of Systematic Reviews (CDSR), and Livivo and included English and German-language literature up to January 2023. Pure case reports, publications with a focus on "Infection", and publications not relating to the previously defined questions were excluded, which is why 1314 of the 1789 references found during the literature search were not considered. The remaining 474 publications were summarized in a multi-stage process methodically and in terms of content and then classified by the guideline steering committee according to the Oxford 2011 Levels of Evidence (*eFigure*). The literature was then made available to all members of the guideline group, together with the steering group's classification and a brief summary of the methodology and content. The guideline was prepared with editorial independence from the funding organization. The members submitted a "Declaration of Interests" online via the AWMF portal.

Results

Chronic kidney disease is rare in young patients, with a prevalence of one percent, and is often diagnosed too late (4, 5). The early warning sign for kidney disease is (glomerular) microhematuria, which is why the urine of children is examined, for example, at the U8 check-up. No other screening assessment is provided for children and young adults unless there is a specific reason. In the following, it will become evident how useful this screening for kidney disease is – provided it is used in accordance with the new guideline. The challenge for doctors is to identify those young patients with potentially dangerous kidney disease in a resource-efficient and cost-effective way, without unsettling or burdening the child and its par-

ents with inadequate diagnostics. This creates the opportunity of delaying, or completely preventing, end-stage kidney failure by early diagnosis and treatment.

First, however, two important terms need to be defined:

Microhematuria—The medical laboratory definition is more than eight red blood cells per μL (7). Urine dip sticks are not capable of distinguishing between hematuria and hemoglobinuria, so a persistent positive finding always requires microscopic examination. Microhematuria in the urine sediment is diagnosed when three or more red cells are detected per high-power field (enlarged 400 times) (4, 7–12). In terms of suitability for daily use, a positive urine dip stick result with a limit of five to ten red cells per μL is sufficient for the diagnosis of "microhematuria".

Acanthocyte—An acanthocyte is an abnormal red cell variant with vesicle-like protrusions in the urine. If the glomeruli are damaged, the red blood cell penetrates through microtears in the glomerular basement membrane and is deformed into an acanthocyte.

When is it advisable to seek a timely specialist consultation for hematuria?

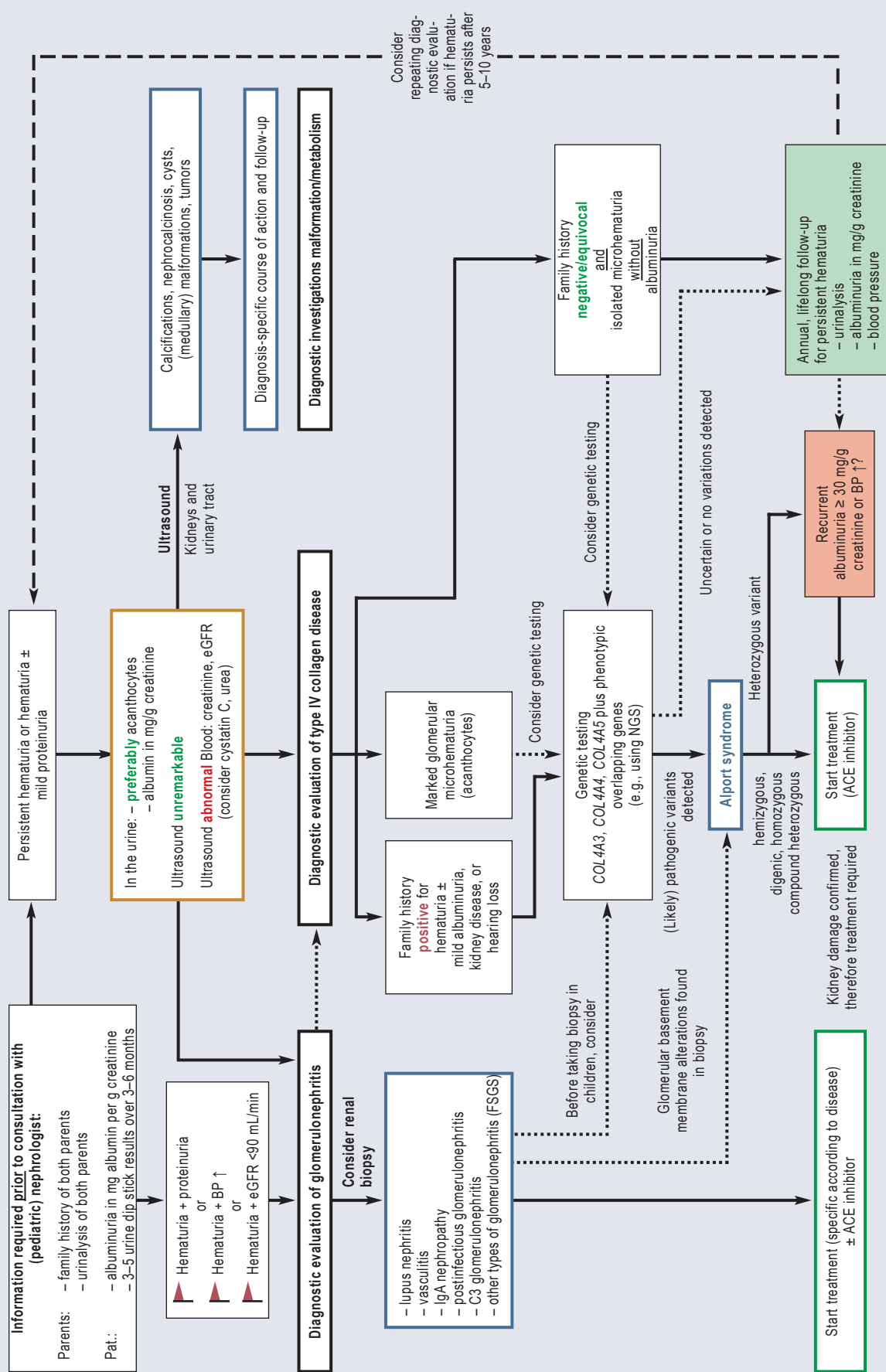
Macrohematuria (blood in urine visible to the naked eye), which is not associated with a urinary tract infection, is always abnormal in the view of all guideline experts and should therefore be investigated promptly by a specialist. If, in addition to microhematuria, proteinuria, hypertension, or renal impairment is present, or if five percent of more acanthocytes are found in the urine, this should always be investigated promptly by a pediatric nephrologist (or nephrologist in the case of an adult).

When is microhematuria considered persistent?

Microhematuria persistent on the urine dip stick is the corner stone for the early diagnosis of chronic kidney disease (*Figure*). Even the isolated finding of "persistent microhematuria" is sufficient as an early characteristic symptom in over ten percent of those affected to establish a genetic underlying cause of microhematuria. This presents the risk of chronic kidney disease. It is therefore generally advisable to undertake repeated checks at intervals of several weeks to months to confirm the persistence of microhematuria in young patients. The persistence of microhematuria is highly indicative of the risk of progression of kidney disease (1, 4, 5). Monitoring with urine dip sticks, for example, has proven to be effective if it is conducted three to five times over a period of three to six months. The diagnosis of persistence requires a positive result for microhematuria on the majority of the dip sticks (for example, two out of three). In this context too, it should be noted that additional factors such as proteinuria, hypertension, impaired renal function, or five percent of more acanthocytes in the urine should always be followed by a prompt (pediatric) nephrological evaluation.

With isolated microhematuria, the expert consensus is therefore that the persistence of hematuria is the decisive factor for assessing its pathological relevance and the need for further nephrological evaluation (*Figure*). Acanthocytes in the urine sediment should be examined in the presence of persistent microhematuria, even though the

Figure



Workflow for evaluation of microhematuria: proposed on the basis of the recommendations as the primary structure and principal component of the guideline

Red flag = fast track, should be clarified immediately by a (pediatric) nephrologist. ACE, angiotensin converting enzyme; eGFR, estimated glomerular filtration rate; FSGS, focal segmental glomerulosclerosis; IgA, immunoglobulin A; NGS, next generation sequencing; pat., patient; BP, blood pressure

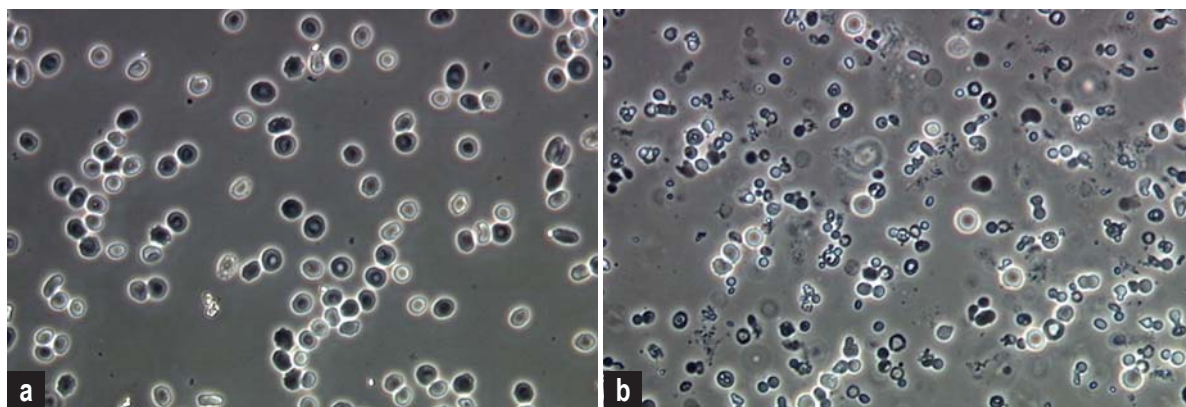


Figure: Microscopic difference between non-glomerular (a) and glomerular hematuria (b)

Photos: Margit Schmude, University Medical Center Mainz

evidence for this recommendation is only moderate: The identification of more than ten percent acanthocytes in urine sediment is an indication of glomerular disease with 98 percent specificity (sensitivity 52 percent) (7). However, due to a lack of appropriately programmed detection software, many automated laboratories are unable to correctly identify acanthocytes in urine sediment, which is why, when in doubt, one should not rely on this detection software but on visual assessment by technical or medical staff (4, 7–12) (*Figure*).

With persistent microhematuria, the possible presence of proteinuria, including albuminuria, should also be confirmed or excluded quantitatively in spontaneous urine in relation to creatinine excretion. This differentiation has a high level of evidence for further diagnostics, serves to distinguish between tubular, glomerular, and mixed tubular-glomerular kidney damage, and is therefore decisive when considering the degree of urgency of further examinations (3, 13–25).

Imaging modality of choice for microhematuria: ultrasound

Ultrasound of the kidneys and urinary tract is the imaging modality of choice with a high quality of evidence. It is very well capable of detecting malformations, kidney stone disease, and congenital anomalies of the kidney and urinary tract (CAKUT). With no radiation exposure and with the least time and effort (and less stress for the patient and family), ultrasound yields the most information gain for the differential diagnostic workup of kidney disease. According to the guideline, more advanced radiological imaging investigations are only recommended by strong consensus if all alternative diagnostic options, including ultrasound by a highly qualified examiner, have been exhausted and have proven to be inconclusive. Experts also recommend with strong consensus and a moderate level of evidence that cystoscopy is not indicated for the evaluation of isolated hematuria in young patients. Invasive urological diagnostic investigations such as cystoscopy are only recommended when ultrasound has demonstrated anomalies of the bladder requiring clarification in this respect and all other diagnostic alternatives have been exhausted.

When is further specialist consultation required?

If persistent microhematuria is present, then the family history and urinalysis of both parents as well as the child's albuminuria expressed as mg/g creatinine and its urine dip stick test results should be obtained prior to the (pediatric) nephrological consultation. Macrohematuria in the absence of urinary tract infection or microhematuria associated with proteinuria, hypertension, impaired kidney function, or with five percent of more acanthocytes should always be promptly examined by a pediatric nephrologist (or, in the case of adults, a nephrologist). For the purposes of specialist evaluation of persistent microhematuria, ultrasound of the kidneys and urinary tract, investigation for acanthocytes, albumin expressed as mg/g creatinine, creatinine and, if necessary, immunoglobulin G (IgG) and alpha-1-microglobulin in the urine as well as cystatin C, creatinine, eGFR, and urea in the blood should be performed. Given the invasive nature of the investigations, blood samples for this purpose should only be taken in children where there is a firm suspicion of a chronic kidney disease.

In most cases, ultrasound together with urine and blood tests allows a narrower definition of differential diagnoses with moderate evidence and enables a decision to be made as to whether, and which, further supplementary examinations need to be conducted.

While spontaneous urine is usually sufficient to clarify the majority of other kidney diseases, metabolic evaluation should be performed where nephrolithiasis or nephrocalcinosis is suspected, with a high level of evidence. Please refer to the S2k Urolithiasis Guideline (AWMF 043–025) (16).

When should a renal biopsy be taken and when should molecular genetic assessment be performed to confirm the diagnosis?

In many cases, renal biopsy will serve to confirm the diagnosis, assess prognosis, and where appropriate help decide treatment for lupus nephritis, vasculitis, C3 glomerulonephritis, IgA nephropathy, and other forms of glomerulonephritis. For specialist evaluation of kidney disease in young adults with persistent microhematuria, molecular genetic diagnostics and/or a kidney biopsy are therefore recommended if there is clinical evidence of

florid glomerular disease (for example, hypertension, proteinuria, and/or impaired renal function) after testing for albumin in the serum, complement C3 and C4, ANA, dsDNA, ANCA, and additional symptoms (proteinuria, hypertension, reduced eGFR). A kidney biopsy should only be considered in children with no proteinuria, no hypertension, and no reduction of eGFR after obtaining molecular genetic diagnostics testing. Depending on the age of the patient, other countries adopt a “genetics first approach”, i.e., genetic testing is carried out before kidney biopsy. However, the dynamics and severity of the symptoms must also be strictly taken into account in this respect. A high-quality molecular genetic assessment is recommended with a strong consensus and high level of evidence for isolated persistent microhematuria of glomerular origin in both children and young adults.

Microhematuria as an early warning sign of Alport syndrome

The most common glomerular kidney disease in childhood and young adulthood is Alport syndrome, a hereditary type IV collagen disease. So, if microhematuria persists, a family history of kidney disease should be taken and an environmental examination of (first-degree) relatives should be arranged (1, 3–5). Microhematuria often goes unnoticed among close relatives. A family history of microhematuria and/or a positive family history for kidney diseases is one of four diagnostic criteria for type IV collagen disease, apart from sensorineural hearing loss and ocular changes, and increases the probability of a diagnosis (3, 14, 17–28). Sensorineural hearing loss (29) and ocular changes (anterior/posterior lenticonus, macula spots, and retinal thinning) (30) are clinical diagnostic criteria for type IV collagen disease which commonly develop in the first two decades of life. Each of these symptoms increases the probability of the diagnosis “type IV collagen disease—Alport syndrome.” The early provision of hearing aids or glasses is required. For further evaluation of kidney disease in children and young adults with persistent microhematuria, supplementary ENT and ophthalmologic examinations are therefore recommended with a high level of evidence and repeated every 3 years if necessary.

Precision medicine in nephrology: molecular genetic diagnostics

Molecular genetic testing should always be performed in young patients with focal segmental glomerulosclerosis (FSGS). It has a high quality of evidence, and the prognosis and treatment as well as the prognosis after kidney transplantation differ fundamentally between non-genetic and genetic forms of FSGS. Type IV collagen disease is the most common cause of persistent microhematuria of glomerular origin in children and young adults (genes: *COL4A3*, *COL4A4*, *COL4A5*) (22). Genetic testing is best practice here, as it also allows the assessment of treatment response and prognosis (high level of evidence).

Medical care for affected families

Uncertainty and anxiety among patients and their relatives while undergoing diagnostic assessment for microhematuria can produce a high level of distress.

Receiving a diagnosis of chronic kidney disease, at the latest, can lead to insecurity, reduced self-esteem, and a low quality of life. Supportive therapy and patient advocacy groups can provide help with a number of problems and improve treatment quality and compliance during multimodal therapy which is often lifelong. Patients should therefore be actively pointed in the direction of patient advocacy groups and contacts established for coping with the illness and everyday life. In addition, patients and/or their relatives should be offered psychosocial support to cope with diagnosis and disease.

Impact of the new guideline

Apart from the early detection of chronic disease, it was particularly important from the perspective of pediatric and adolescent medicine and patient representatives that this guideline helps avoid excessive diagnostics by arranging for CT, MRI, or cystoscopy. According to the German Federal Association for Patients With Kidney Diseases, care pathways for the early detection and treatment of kidney disease give doctors confidence and involve patients and their parents in the treatment process, for example, by offering information tailored to the target group, thus strengthening the joint decision-making process.

The implementation of courses of action suitable for everyday use in the new S3 guideline provides the opportunity of delaying renal failure in many young patients through early diagnosis and treatment (*Figure*). The early use of urine dip sticks is resource-efficient, cost-effective, and associated with the hope of improving prognosis (31).

Further need for research

Important research questions include: How do acanthocytes originate? And: How can this process be best detected as an early warning sign? Are there medications, specific forms of sports that often require the use of maximum strength, infections, or nutrition that promote the development of acanthocyturia? When and how often are pediatric findings benign over the long term and how often are they malignant in terms of chronic kidney disease?

The effect of psychological and social interventions for microhematuria and their underlying conditions (for example, Alport syndrome, IgA nephritis) has so far not been investigated in studies. Uncertainty and anxiety of patients and their relatives produce a high level of distress. The poorer adherence to treatment and poorer outcome are therefore a medical problem for the long-term care of children and young adults with chronic kidney disease. Therefore, a study involving a defined patient group (for example, those in stage two to three chronic kidney disease) with and without psychosocial intervention together with documentation of the outcome is proposed.

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Conflict of interest statement

The authors declare that they have no conflicts of interests.

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Clinical practice guidelines in the *Deutsches Ärzteblatt*, as in many other journals, are not subject to a peer review process, since clinical practice (S3 level) guidelines are texts which have already been evaluated, discussed, and broadly agreed upon multiple times by experts (peers).

References

- Gross O, Licht C, Anders HJ, et al.: Early angiotensin-converting enzyme inhibition in Alport syndrome delays renal failure and improves life expectancy. *Kidney Int* 2012; 81: 494–501.
- Gross O, Kashtan CE, Rheault MN, et al.: Advances and unmet needs in genetic, basic and clinical science in Alport syndrome: report from the 2015 Int. Workshop on Alport Syndrome. *Nephrol Dial Transplant* 2017; 32: 916–24.
- Kashtan CE, Gross O: Clinical practice recommendations for the diagnosis and management of Alport syndrome in children, adolescents, and young adults. *Pediatr Nephrol* 2021; 36: 711–9.
- Kallash M, Rheault MN: Approach to persistent microscopic hematuria in children. *Kidney* 2020; 1: 1014–20.
- Calderon-Margalit R, Golan E, Twig G, et al.: History of childhood kidney disease and risk of adult end-stage renal disease. *N Engl J Med* 2018; 378: 428–38.
- ESCAPE Trial Group; Wühl E, Trivelli A, et al.: Strict blood-pressure control and progression of renal failure in children. *N Engl J Med* 2009; 361: 1639–50.
- Köhler H, Wandel E, Brunc B: Acanthocyturia—a characteristic marker for glomerular bleeding. *Kidney Int* 1991; 40: 115–20.
- Fogazzi GB, Edefonti A, Garigali G, et al.: Urine erythrocyte morphology in patients with microscopic haematuria caused by a glomerulopathy. *Pediatr Nephrol* 2008; 23: 1093–100.
- Fünfstück R, Stein G: [Erythrocytes in the urine: glomerulonephritis or other source of bleeding. Answer with the microscope]. *MMW Fortschr Med* 2000; 142: 30–2.
- Hicks J, Mierau G, Wartchow E, Eldin K: Renal diseases associated with hematuria in children and adolescents: a brief tutorial. *Ultrastruct Pathol* 2012; 36: 1–18.
- Meyers KEC: Evaluation of hematuria in children. *Urol Clin North Am* 2004; 31: 559–73.
- Brown DD, Reidy KJ: Approach to the child with hematuria. *Pediatr Clin North Am* 2019; 66: 15–30.
- van den Belt SM, Heerspink HJL, Gracchi V, et al.: Early proteinuria lowering by angiotensin-converting enzyme inhibition predicts renal survival in children with CKD. *J Am Soc Nephrol* 2018; 29: 2225–33.
- Gross O, Tönshoff B, Weber LT, et al.: A multicenter, randomized, placebo-controlled, double-blind phase 3 trial with open-arm comparison indicates safety and efficacy of nephroprotective therapy with ramipril in children with Alport's syndrome. *Kidney Int* 2020; 97: 1275–86.
- Boeckhaus J, Hoefele J, Riedhammer KM, et al.: Lifelong effect of therapy in young patients with the COL4A5 Alport missense variant p.(Gly624Asp): a prospective cohort study. *Nephrol Dial Transplant* 2022; 37: 2496–504.
- Seitz C, Bach T, Bader M, et al.: Aktualisierung der S2k-Leitlinie zur Diagnostik, Therapie und Metaphylaxe der Urolithiasis (AWMF Registernummer 043–025). *Urologe* 2019; 58: 1304–12.
- Algoet C, Proesmans W: Renal biopsy 2–9 years after Henoch Schönlein purpura. *Pediatr Nephrol* 2003; 18: 471–3.
- Hogg R: An evaluation of the roles of hematuria and uric acid in defining the prognosis of patients with IgA nephropathy. *Pediatr Nephrol* 2022; 37: 947–58.
- Suh JS, Jang KM, Hyun H, et al.: Remission of proteinuria may protect against progression to chronic kidney disease in pediatric-onset IgA nephropathy. *J Clin Med* 2020; 9: 2058.
- Alshami A, Roshan A, Catapang M, et al.: Indications for kidney biopsy in idiopathic childhood nephrotic syndrome. *Pediatr Nephrol* 2017; 32: 1897–1905.

- Devasahayam J, Erode-Singaravelu G, Bhat Z, et al.: C1q nephropathy: the unique underrecognized pathological entity. *Anal Cell Pathol (Amst)* 2015; 2015: 490413.
- Kashtan CE, Adam MP, Feldman J, et al.: Alport Syndrome. *GeneReviews*® [Internet]. Seattle (WA): University of Washington, Seattle; 1993, 2001, [updated 2019 Feb 21]. PMID: 20301386.
- Kovács G, Kalmár T, Endreffy E, et al.: Efficient targeted next generation sequencing-based workflow for differential diagnosis of alport-related disorders. *PLoS One* 2016; 11: e0149241.
- Goka S, Copelovitch L, Levy Erez D: Long-term outcome among females with Alport syndrome from a single pediatric center. *Pediatr Nephrol* 2021; 36: 945–51.
- Zhang L, Sun BC, Zhao BG, Ma QS: An overview of the multi-pronged approach in the diagnosis of Alport syndrome for 22 children in Northeast China. *BMC Nephrol* 2020; 21: 294.
- Tiebosch AT, Frederik PM, van Breda Vriesman PJ, et al.: Thin-basement-membrane nephropathy in adults with persistent hematuria. *N Engl J Med* 1989; 320: 14–8.
- Gross O, Netzer KO, Lambrecht R, Seibold S, Weber M: Meta-analysis of genotype-phenotype correlation in x-linked alport syndrome: impact on clinical counselling. *Nephrol Dial Transplant* 2002; 17: 1218–27.
- Alge JL, Bekheirnia N, Willcockson AR, et al.: Variants in genes coding for collagen type IV α -chains are frequent causes of persistent, isolated hematuria during childhood. *Pediatr Nephrol* 2023; 38: 687–95.
- Boeckhaus J, Strenzke N, Storz C, Gross O, on behalf of the Gpn Study Group, Early Pro-Tect Alport Investigators: Characterization of sensorineural hearing loss in children with alport syndrome. *Life (Basel)* 2020; 10: 360.
- Pfau K, Gross O, Bemme S, et al.: [Ocular alterations in patients with Alport syndrome—an update]. *Ophthalmologie* 2023; 120: 645–51.
- Häckl D, Kossack N, Schoenfelder T: [Prevalence, costs of medical treatment and modalities of dialysis-dependent chronic renal failure in Germany: comparison of dialysis care of nursing home residents and in outpatient units]. *Gesundheitswesen* 2021; 83: 818–28.

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Supplementary material

eFigure, eTable:
www.aerzteblatt.de/m2024.0070

Erratum

The English version of the article “Neoplasms of the Appendix” by Köhler et al. (*Dtsch Arztebl Int* 2023; 120: 519–25. DOI: 10.3238/arztebl.m2023.0136) contained an error. In the section entitled “Adenocarcinomas of the appendix,” the need for right oncologic hemicolectomy with systematic lymphadenectomy exists in pT2 tumors and higher-grade tumors—i.e., pT2 tumors are included.

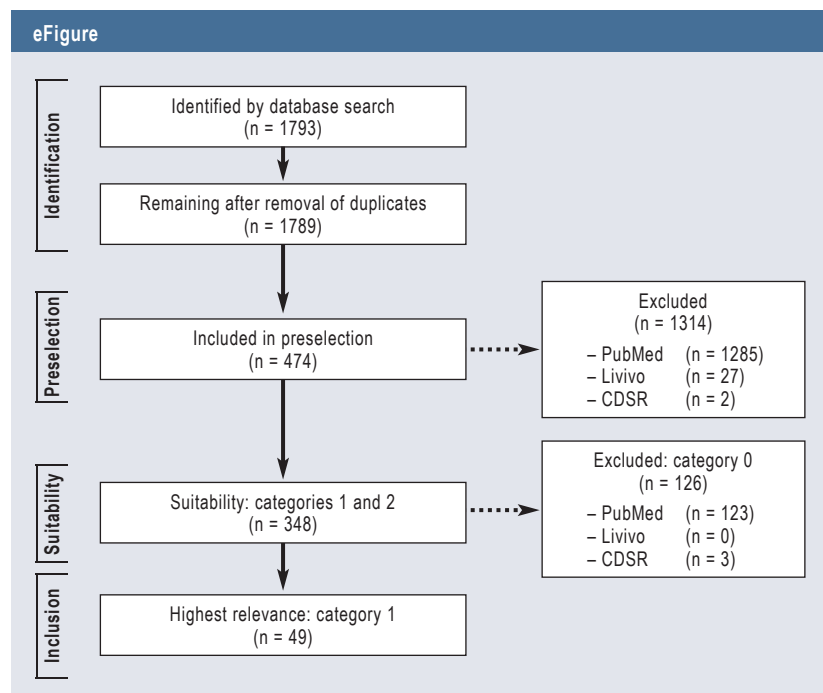
Supplementary material to accompany the article

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PRISMA flow diagram of the bibliographic database search – search strategy structure

PubMed, Public Medicine (medical database of the US-American National Institutes of Health); Livivo, internet-based search portal for live sciences; CDSR, Cochrane Database of Systematic Reviews

eTable

Members of the guideline group comprising the participating professional societies and their representatives

Representatives	Professional society/Organization
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